Fig. 1   A see through view of a LCD panel and its ITO electrodes

V_{SEGj}

V_1 V_2 V_3 V_4 V_6

V_{COMi}

V_1

V_6

24

22

Pair of COM electrodes going through opposite transitions

V_{COMi+1}

V_1

V_6

|← —— Field 2×N —— →|← —— Field 2×N+1 —— →|

Fig. 2   Wave forms for COM electrodes and SEG electrodes

OD

Vi → Output Driver → Si   SPi   SNi   COMi
I = c-1   SCi

Vi → Si   SPi   SNi   COMi
I = c   SCi

Vi → Si   SPi   SNi   COMi
OD
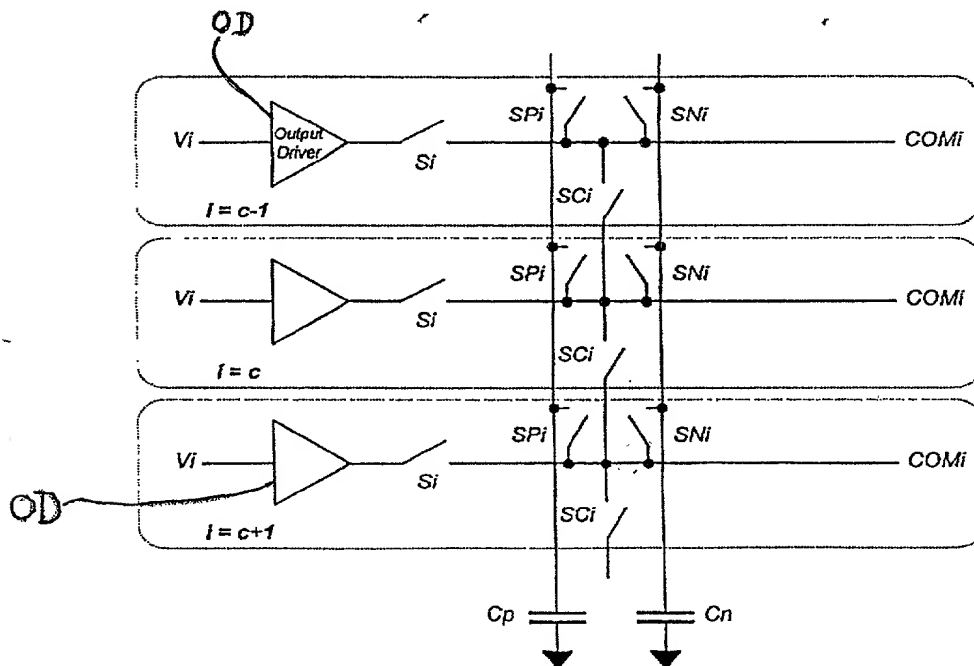I = c+1   SCi

Cp   Cn

Fig. 3   Schematics for portion of the control circuit related to the present invention

Transition	Positive going				Negative going			
Time	t0	t1	t2	t3	t0	t1	t2	t3
SPi			X		X			
SCi		X				X		
SNi	X						X	
Si				X				X

Fig. 4   Relationship between COM signal transition and the operations of switch SPi, SNi, SCi, and Si (X: close, blank: open)

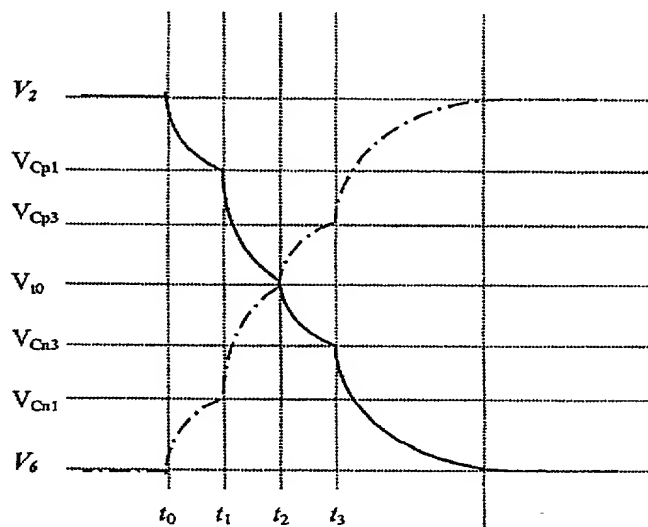
Fig 5.   Detailed COM electrode waveform corresponding to the oval circle in Fig. 2 and the switch action sequence in Fig. 4. The solid line and the dotted line are the waveforms of a pair of COM electrodes going through opposite transitions (e.g. V_{COMi} and V_{COMi+1}).
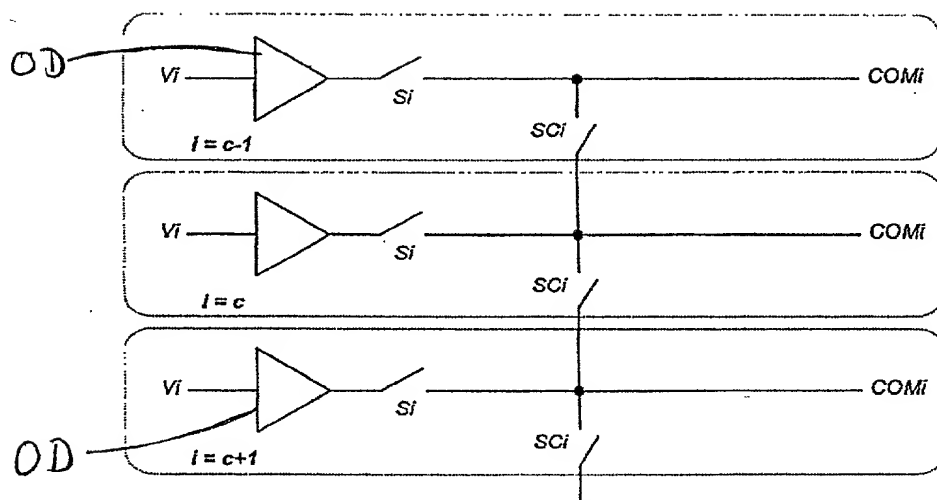
Fig. 6   Schematic for simplified alternative implementation.
No switch SPi, SNi, and no storage capacitors Cp, Cn

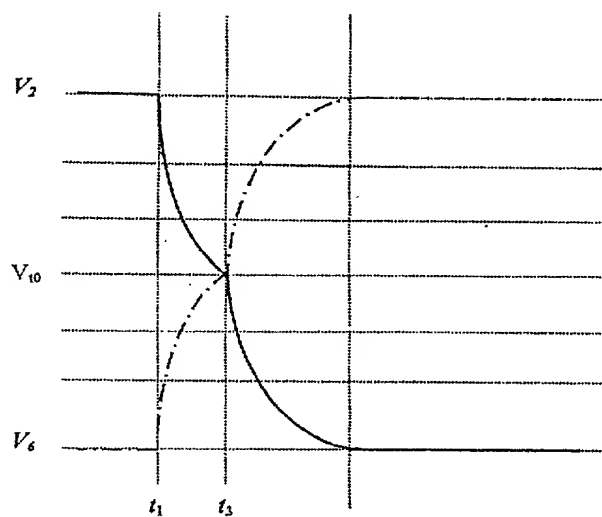Charge Conserving Passive LCD Driving Scheme

Fig. 7   Waveform for the alternative implementation.
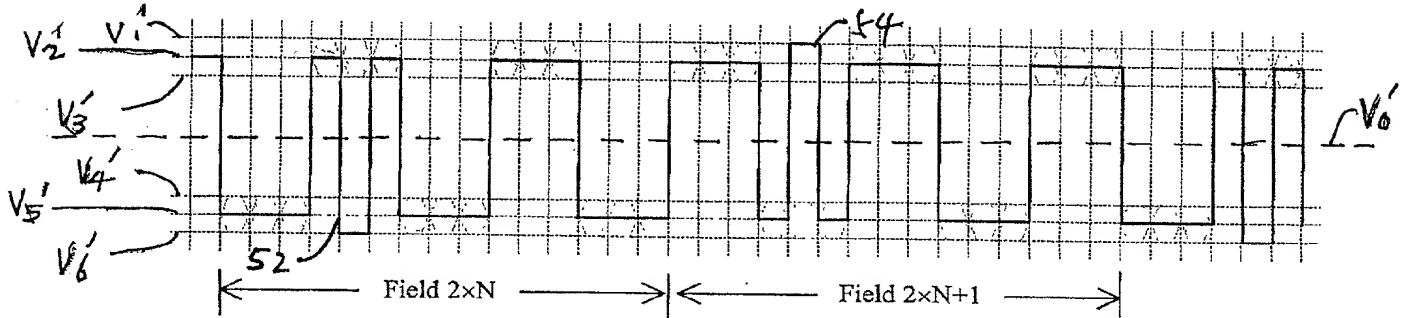
An example of 3-line inversion Wave forms
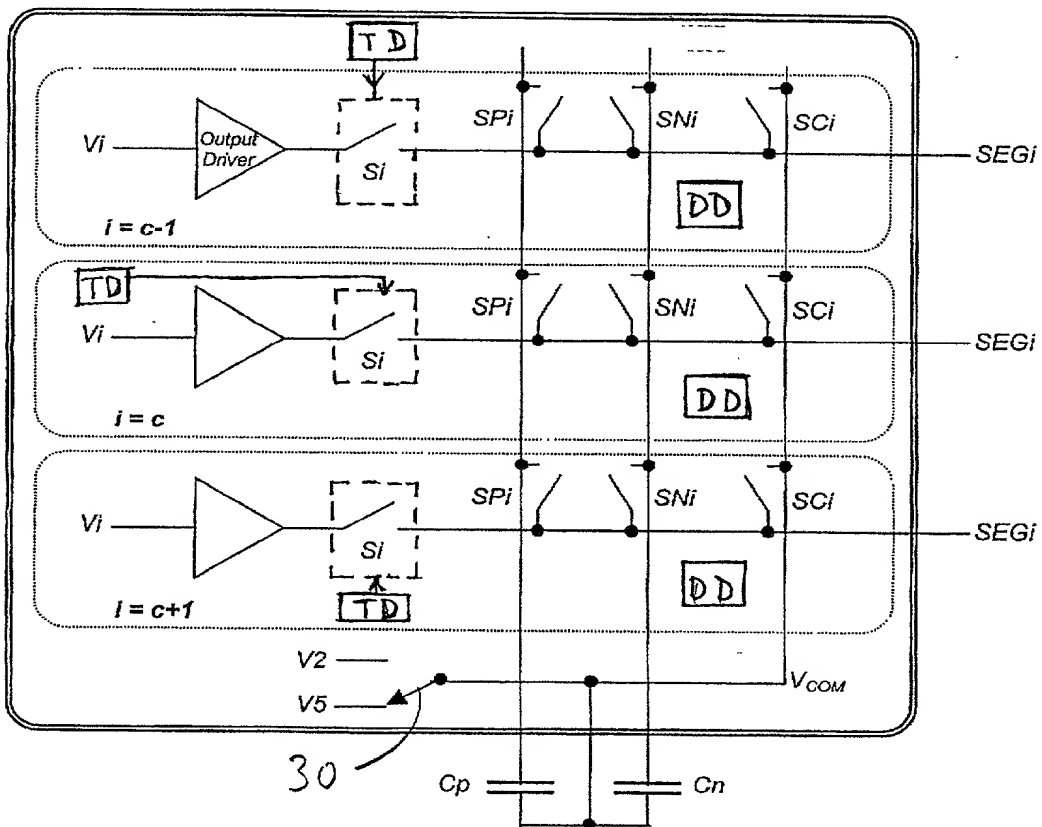

FIG. 11

Circuit Schematics and Operation
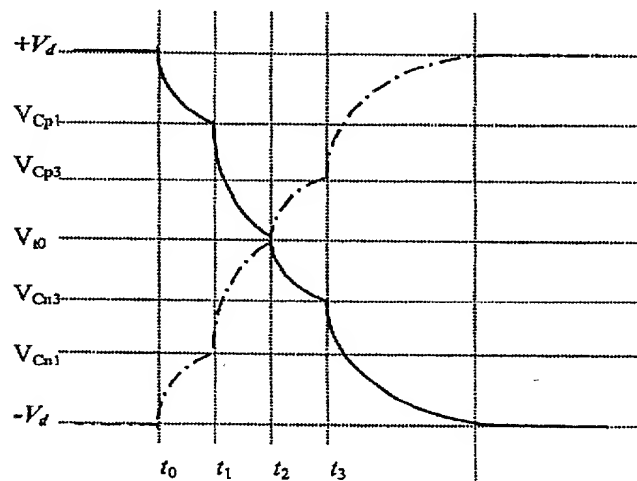

FIG. 8

Transition	Positive going (TD=1, DD=1)				Negative going (TD=1, DD=0)			
Time	t0	t1	t2	t3	t0	t1	t2	T3
SPi			X		X			
SCi		X				X		
SNi	X						X	
Si				X				X

FIG. 9

Relationship between V_{SEG}-V_{COM} transition and the operations of switch SPi, SNi, SCi, and Si (X: CLOSE, blank: OPEN). When TD=0, then S is always CLOSE, while SP, SN, SC are always OPEN.

Detailed V_{SEG} – V_{COM} wave forms corresponding to the switch action sequence in Fig. 4. The solid line illustrate a negative going transition and the dotted line illustrate a positive going transition. The value of Vt0 depends on the mixture of "matching" transitions (as discussed in the following paragraph) and may not be near the mid point between Vcp1/Vcp3 and Vcn1/Vcn3, as may appear to be implied in the above figure.

FIG. 10

FIG. 2A
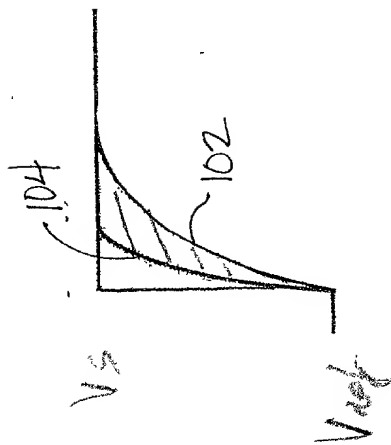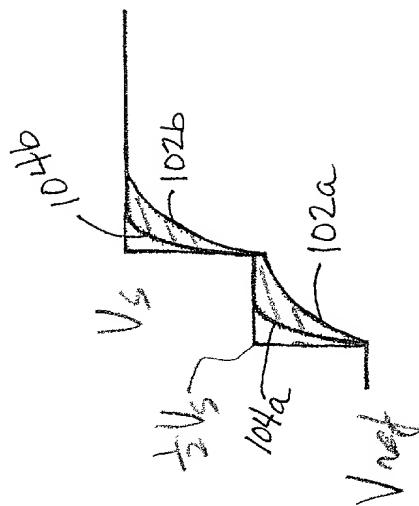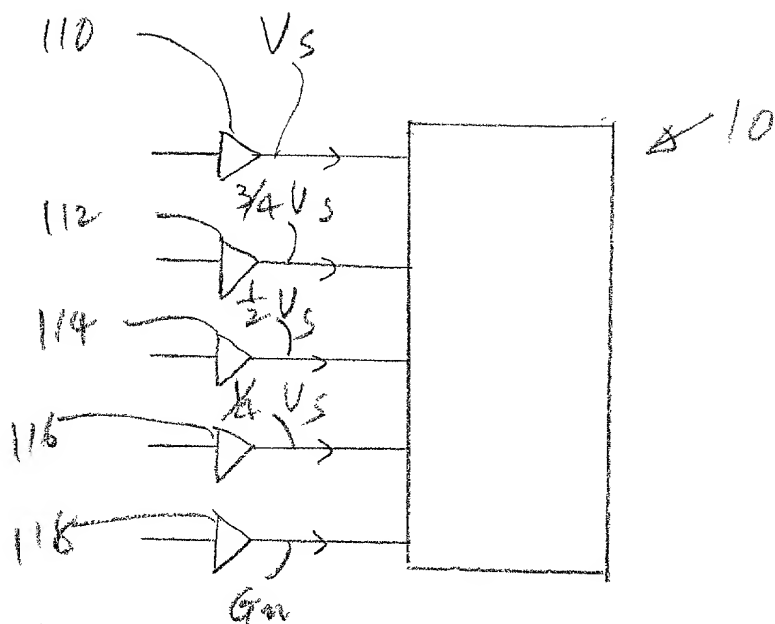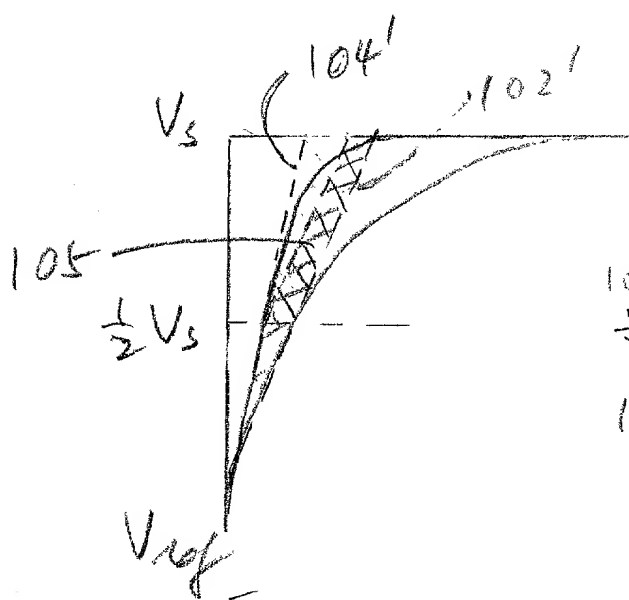

FIG. 12B

110 V_S

$\frac{3}{4} V_S$

112

$\frac{1}{2} V_S$

114

$\frac{1}{4} V_S$

116

118

G_m

10

FIG. 14

V_S

104' 102'

105

$\frac{1}{2} V_S$

V_{ref}

FIG. 13A

104b' 104b 102b'

V_S

102b

104a' 102a'

$\frac{1}{2} V_S$

104a 102a

FIG. 13B